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# BMJ Open A cross-sectional analysis of pharmaceutical industry-funded events for health professionals in Australia

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## ABSTRACT

**Objectives** To analyse patterns and characteristics of pharmaceutical industry sponsorship of events for Australian health professionals and to understand the implications of recent changes in transparency provisions that no longer require reporting of payments for food and beverages.

**Design** Cross-sectional analysis.

**Participants and setting** 301 publicly available company transparency reports downloaded from the website of Medicines Australia, the pharmaceutical industry trade association, covering the period from October 2011 to September 2015.

**Results** Forty-two companies sponsored 116 845 events for health professionals, on average 608 per week with 30 attendees per event. Events typically included a broad range of health professionals: 82.0% included medical doctors, including specialists and primary care doctors, and 38.3% trainees. Oncology, surgery and endocrinology were the most frequent clinical areas of focus. Most events (64.2%) were held in a clinical setting. The median cost per event was \$A263 (IQR \$A153–1195) and over 90% included food and beverages.

**Conclusions** Over this 4-year period, industry-sponsored events were widespread and pharmaceutical companies maintained a high frequency of contact with health professionals. Most events were held in clinical settings, suggesting a pervasive commercial presence in everyday clinical practice. Food and beverages, known to be associated with changes to prescribing practice, were almost always provided. New Australian transparency provisions explicitly exclude meals from the reporting requirements; thus, a large proportion of potentially influential payments from pharmaceutical companies to health professionals will disappear from public view.

## INTRODUCTION

Full disclosure of financial relationships between the pharmaceutical industry and health professionals is a key strategy adopted to make these interactions more transparent. Many jurisdictions have recently introduced transparency provisions, including the USA and the European Union, but the extent of the disclosure obligation varies. For example, meals and drinks fall outside the scope of disclosure obligations under new voluntary

## Strengths and limitations of this study

- From publicly available reports released under Australian transparency rules, we have created a searchable world-first database with details of more than 100 000 industry-sponsored events for health professionals, enabling researchers to analyse the intersection of pharmaceutical marketing and medical education.
- In order to analyse the database, we iteratively identified a set of keywords for each variable of interest; however, it is possible that some synonyms were missed.
- We relied on data as presented in the Medicines Australia transparency reports, and we did not verify the accuracy and completeness of data.
- Transparency requirements apply only to member companies, excluding manufacturers of generics, over-the-counter and non-member prescription medicine manufacturers; thus, our analysis likely underestimates the true extent of industry sponsorship of events for health professionals.

transparency provisions introduced by the European Federation of Pharmaceutical Industry Associations.<sup>1</sup> At the same time, in the USA, over 100 medical societies recently backed a bill that would exempt pharmaceutical and medical device companies from reporting an entire category of payments to doctors: those related to continuing medical education.<sup>2</sup>

Australia was one of the first countries to move towards public reporting of these payments. Since 2007, Medicines Australia, the trade association of the prescription medicines industry, has required member companies to provide detailed reports of sponsorship of events for health professionals, which include company-initiated events, sponsored events organised by a third party, trade displays at educational events and sponsorship of healthcare professionals to attend events both in Australia and overseas.<sup>3</sup> The reports are published on the Medicines

Australia website and include events for all registered healthcare professionals, making Australia one of the few countries with transparency extending to non-physicians.<sup>4,5</sup> These disclosure provisions were a condition for approval of Medicines Australia's Code of Conduct by the Australian Competition and Consumer Commission and were upheld following a legal appeal by industry.<sup>6</sup> Changes to this policy were introduced in 2015, with the focus on events replaced by disclosure of payments to individuals.<sup>3</sup> The reports detailing event sponsorship and aggregate payments to health professionals have been discontinued, and replaced with reports of payments to named individuals, similar to the Open Payments database in the USA. Moreover, the new code no longer requires reporting of payments for food and beverages.

At a time when disclosure policies are being debated and revised in several settings,<sup>1-3</sup> Australian data can provide valuable insights into patterns of industry sponsorship and on characteristics of transparency provisions that are needed to capture expenditures of pharmaceutical companies on health professionals. Apart from two analyses of data from the first 6 months of the Australian disclosure scheme,<sup>4,7</sup> and one brief report on events involving nurses,<sup>5</sup> no comprehensive longer term analyses have been conducted.

The objectives of this cross-sectional analysis are to describe the nature and frequency of events for health professionals sponsored by pharmaceutical companies that are members of Medicines Australia; to create an open-access searchable database of these events; and to estimate the information that will be lost under newly introduced reporting standards.

## METHODS

### Data sources

We downloaded all the available reports from the Medicines Australia website ([www.medicinesaustralia.com.au](http://www.medicinesaustralia.com.au)) in PDF format. The 301 PDF reports of approximately 15 000 pages covered the period October 2011 to September 2015. The PDFs had been originally created in Microsoft Excel. We requested the original Excel files from Medicines Australia but were refused on the basis that member companies had not given permission for their release. We converted the PDF files into Excel format using free, online converter programs, cleaned the data to address errors introduced during file conversion, and ensured consistency of reporting in each column.

The reports cover information on the sponsoring company, timing, venue type, number and profession of participants, hospitality and travel for attendees, room rentals and equipment, and speaker honoraria.<sup>3</sup>

Over this 4-year period, 47 pharmaceutical companies issued transparency reports, and we grouped them based on mergers and acquisitions as of 31 March 2016. Therefore our analysis included 42 Medicines Australia member companies; as a frame of reference, there are

approximately 140 separate companies listed as suppliers to the Australian Pharmaceutical Benefit Scheme.<sup>8</sup>

### Coding

We designed a coding scheme based on the available data and variables of theoretical interest based on the literature on industry–professional interactions<sup>9,10</sup> and on two previous analyses of data from the first 6 months of the Australian disclosure scheme.<sup>4,7</sup> The research team iteratively developed a set of keywords to define each variable of interest (see online supplementary file 1). Using Excel's filter function, we used the keywords to search the unstructured descriptive text and to dichotomously code event features as 'present/absent', for the following variables:

- ▶ sponsoring companies, grouped based on mergers and acquisitions as of 31 March 2016
- ▶ geographical location by Australian state or overseas location
- ▶ professional status of attendees (eg, specialists, nurses, trainees)
- ▶ clinical focus based on clinical specialty of attendees and event description (eg, oncology, endocrinology, cardiology)
- ▶ type of event (eg, journal club, workshop, in-services)
- ▶ type of hospitality provided (eg, breakfast, lunch, dinner).

### Statistical analysis

We present frequency tables for the characteristics of the events, and median spending levels per event and company. Cost variables are reported in Australian dollars. As the data were not normally distributed, we used Mann-Whitney U tests for the differences between medians. Analyses were performed using SPSS V.22.

## RESULTS

### General overview

From October 2011 to September 2015, 42 pharmaceutical companies in Australia sponsored 116 845 events involving health professionals. On average, there were 2434 events per month and 608 events per week. Each year, the number of events sharply decreased in December through February, likely reflecting the holiday season.

Table 1 provides illustrative examples of sponsored events as presented verbatim in the company reports, chosen to reflect variations in reporting and event type. Events varied greatly in scope and intensity, ranging from a half-hour journal club with sandwiches in a hospital meeting room, to a several-day conference with overseas flight, accommodation and hospitality provided. The professional status was sometimes described generically as 'healthcare professionals' or contained a list of the professions in attendees. The level of detail companies reported regarding the programme's content and the extent of explicit product promotion also varied; most of the event descriptions were disease-focused (eg, 'Journal



Club on Chronic Obstructive Pulmonary Disease'), but in some cases the events mentioned specific drug names (eg, 'Introducing Zoely and other Emerging Trends in Contraception').

### Attendees

Over this 4-year period, there were 3 481 750 individual attendances at industry-sponsored events. The median number of event attendees was 18 (IQR 12–25); 97.2% (n=113 595) of the events had fewer than 100 attendees and 0.2% (n=210) had more than 1000 participants. Over 40% (n=47 084) of events included participants from multiple professions. Table 2 lists the professional status of attendees and the most frequent clinical areas of focus for the events. Events were most frequently oncology-related, while otolaryngology and andrology were least represented.

### Location and characteristics of sponsored events

Three-quarters of events were held in the three Australian states with the largest populations — New South Wales (30.7%, n=35 888), Victoria (26.9%, n=31 448) and Queensland (18.8%, n=21 963) — and few were held overseas (1.9%, n=2262). Nearly two-thirds of events (64.2%, n=74 998) were held in a clinical setting, such as hospitals, clinics or doctors' offices. Non-clinical venues included restaurants, hotels and convention centres. One-third of the events were described as a generic 'meeting' (37.5%, n=43 810), while others were described as journal clubs (28.5%, n=33 281), clinical meetings (3%, n=3533), grand rounds (3.8%, n=4472), in-services (2.6%, n=3038) or workshops (2.6%, n=3029). Only 4.2% (n=4290) were described as scientific meetings (eg, conferences or congresses).

### Costs and hospitality

Reporting companies spent \$A286 117 928 on events for health professionals. On average, companies spent \$A2449 per event (SD \$A15 020), while the median cost was \$A263 (IQR \$A153–1195). The median cost per person was \$A14 (IQR \$A10–68). In 81.7% of the events (n=95 483), the costs were below \$A100 per attendee, and in 2.1% (n=2438) the costs were over \$A1000 per attendee.

Table 3 shows the median cost per person by characteristics of events. The median total cost per person was significantly higher when the event format was a scientific meeting such as a congress or conference (\$A93, IQR \$A33–659) compared with other event types (p<0.001), for events held overseas (\$A710, IQR \$A91–7300) compared with events held in Australia (p<0.001), or outside the clinical settings (\$A91, IQR \$A28–154) as compared with events in the clinical setting (p<0.001).

Reported 'hospitality or financial support' provided to attendees included registration fees, travel, accommodation, parking and food and beverage. Food was provided at 90.4% (n=105 667) of events: 22.2% included lunches (n=25 935), 17.0% dinners (n=19 873), 12.0%

teas (n=14 067), 11.0% breakfasts (n=12 806), 2.7% were all-day events with meals (n=3113), and for 25.6% (n=29 873) the type of food and beverage was unspecified. The total cost of food was more than \$A84 million (\$A84 862 791), accounting for 29.7% of the total cost of these functions. However, for 65% (n=75 949) of events, the total listed cost for food and beverage was equal to the listed total cost of the event, indicating that the company's sponsorship extended to food and beverage only. The median cost of food per person was \$A12 (IQR \$A8–20).

### The top companies

Of the 42 pharmaceutical companies that provided reports, the top five in terms of the numbers of sponsored events were AstraZeneca, Novartis, Merck Sharp & Dohme, Roche and Pfizer (table 4). Boehringer Ingelheim had the highest cost per event, with a median cost of \$A2007 (IQR \$A1308–2654), while Eli Lilly spent the least with a median cost per function of \$A145 (IQR \$A62–455). Table 4 provides an overview of event sponsorship by the top 20 companies, representing 87.8% of events.

### Availability of database

The analysable dataset in CSV file format we have created is available at (<http://dx.doi.org/10.4227/11/592631edbd-9d5>) (Direct link to the dataset: <https://research-data.sydney.edu.au/index.php/s/npni79P4NhVQ0XB>)

## DISCUSSION

Pharmaceutical industry-funded events for health professionals were frequent and pervasive, with almost three and a half million individual attendances at over 116 000 events in the 4-year period between 2011 and 2015. As a frame of reference, in 2014 there were 610 148 registered health professionals in Australia,<sup>11</sup> suggesting that there was wide exposure to these events. Events typically included a broad range of professionals and multidisciplinary teams, including most commonly medical specialists, nurses, trainees and primary care doctors. Nearly two-thirds of events were held in clinical settings. Average costs per person were modest, and the vast majority of events (90.4%) included the provision of food and beverages. Additionally, for most events (65%), the only funding provided was for food and beverages. Thus, our analysis suggests that the new Australian and European transparency rules will decrease transparency because hospitality in the form of food and/or beverages will be exempt from reporting.<sup>13</sup>

Although professional education is critical for improving patient care, previous studies of internal pharmaceutical industry documents have shown that sponsored events have been effectively used as a marketing tool.<sup>12 13</sup> A systematic review from 2010 found that with rare exceptions, exposure to pharmaceutical industry information is associated with either no effect on prescribing or with adverse effects such as lower prescribing quality, higher frequency or costs.<sup>14</sup>



**Table 1** Illustrative examples of industry-sponsored events\*

Company	Date	Event content	Venue	Professional status of attendees	Hospitality provided	Total cost of hospitality	Number of attendees	Total costs of function
AstraZeneca	Sep. –15	Educational Event - Dinner meeting Going for Goal: Optimising Treatment in Type 2 Diabetes and Incretin Based Therapies; and On the Road to Glycemic Control. 2 hours educational content	Hotel Realm Barton, ACT	General Practice Nursing Endocrinology	Dinner with Alcoholic and Non-Alcoholic Beverages	\$2087.27	32	\$3305.45 includes 1 speaker fee for \$1218.18
AstraZeneca	Mar. –15	Educational Event - Lunch meeting Restless Legs. 1 hour educational content	The Golden Horse Footscray, VIC	General Practice Respiratory Medicine	Lunch	\$248.82	10	\$848.82 includes speaker fee for \$600
Novartis	Feb. –15	Sponsorship of Journal Club on: Chronic Obstructive Pulmonary Disease 1 hour educational content	Gold Coast University Hospital Southport, QLD	Medical Students, Nurses, Pharmacists	Afternoon Tea	\$184 includes Food & Beverages for 20 delegates \$184	20	\$184 includes Total Hospitality: \$184
Novartis	Mar. –14	Sponsorship of Day Seminar on: Immunosuppressant 8 hours educational content	Alfred Health Melbourne, VIC	Cardiologists, Nurses, Registrars, Renal Physicians, Surgeons, Transplant Physicians	Breakfast, Coffee, Lunch, Afternoon Tea, Light Refreshments, Morning Tea, Non-Alcoholic Beverages	\$2498 includes Food & Beverages for 120 delegates: \$2498	120	\$2,665 Includes Total Hospitality: \$2,498 Speaker Costs: Meal (for 8 speakers): \$167
Merck Sharp & Dohme Australia	Oct. –11	Oncology Journal Club [hours of education=1]	Mercy Women's Hospital, Heidelberg, VIC	Oncologists, Nurses	Food & beverages	food & bev 19.64, Total Hospitality 19.64	5	Total Costs \$19.64
Merck Sharp & Dohme Australia	Oct. - 11	Evening educational meeting 'Introducing Zoely and other Emerging Trends in Contraception' [hours of education=2.5]	Boathouse by the Lake, Barton, ACT	Obstetricians and Gynaecologist	Food & beverages	food & bev 1432.72, Total Hospitality 1432.72	25	speaker fee 688.36, speaker food & bev \$59.07, Total Cost \$2180.15
Roche Products	Apr. –14	Multi Disciplinary Breast Cancer Clinical Review Meeting Educational Content=1 hour	Royal Adelaide Hospital North Terrace Adelaide, SA	Surgery Doctor Oncology Doctor Oncology Nurse Pathology Doctor	Lunch	247	13	247
Roche Products	Jan. - 13	Grand Rounds Educational Content=1 hour 15 mins	Bunbury Regional Hospital Bussell Highway Bunbury, WA	Hospital Healthcare Professionals	Lunch	\$272	20	\$272
Pfizer Australia	Apr. –13	Pfizer Australia provided Sponsorship for Healthcare Professional to attend The European Congress of Clinical Microbiology and Infectious Disease (ECCMID) 2013. Educational Content - 33.75 hour(s).	International Congress Centrum, Berlin, Germany	Infectious Disease Specialist	Registration Fee (1 attendee \$878), Travel (Flights \$8,196, Transfers \$219), Accommodation (6 Room Nights \$1,562)	\$10 855	1	\$10855.00

Continued



Table 1 Continued

Company	Date	Event content	Venue	Professional status of attendees	Hospitality provided	Total cost of hospitality	Number of attendees	Total costs of function
Pfizer Australia	Jun. -15	Journal Club - Chronic Pain, Educational Content - 1 hour(s).	Peter MacCallum Cancer Centre, East Melbourne, VIC	Palliative Care Nurse; Palliative Care Physician	Meal / Drinks	\$156	15	\$156

\*Illustrative examples extracted verbatim from Medicines Australia transparency reports.

Table 2 Professional status of attendees and clinical areas of focus for the events (n=116845)

Characteristics	Number of events	Per cent
Professional status of attendees*		
Medical specialists	80 060	68.5
Nurses	46 214	39.6
Trainees	44 774	38.3
Primary care doctors	24 662	21.1
Pharmacists	9 781	8.4
Clinical areas of focus		
Oncology	22 987	19.7
Surgery	13 306	11.4
Endocrinology	12 655	10.8
Cardiology	9 033	7.7
Haematology	8 200	7.0
Respiratory medicine	7 659	6.6
Psychiatry	6 252	5.4
Nephrology	6 199	5.3
Gastroenterology	5 643	4.8
Pathology	5 361	4.6
Neurology	4 259	3.6
Urology	4 259	3.6
Radiology	3 667	3.1
Infectious diseases	3 348	2.9
Geriatrics	3 134	2.7
Anaesthesiology	2 746	2.4
Rheumatology	2 671	2.3
Paediatrics	1 994	1.7
Allergy/Immunology	1 398	1.2
Ophthalmology	1 365	1.2
Palliative care	1 319	1.1
Intensive care	1 147	1.0
Sexual health	955	0.8
Dermatology	913	0.8
Obstetrics/Gynaecology	878	0.8
Emergency	875	0.7
Internal medicine	418	0.4
Neonatology	363	0.3
Nuclear medicine	357	0.3
Pharmacology	219	0.2
Otolaryngology	31	0.03
Andrology	18	0.02

\*Percentages do not add to 100 because multiple types of professionals could attend an event.

More recently, analyses of the Open Payments database in the USA have shown that payments for educational training and even the provision of low-cost free meals, commonly provided at sponsored events, are associated

**Table 3** Characteristics of events and median cost per person

	Number of events n=116845, n (%)	Median total cost per person* (IQR)
Location		
Overseas	2262 (1.9%)	\$A710 (91–7300)
Within Australia	114583 (98.1%)	\$A14 (10–62)
Setting		
Clinical setting	74998 (64.2%)	\$A12 (9–15)
Non-clinical setting	41847 (35.8%)	\$A91 (28–154)
Event type		
Scientific meeting (eg, congress, conferences)	4920 (4.2%)	\$A93 (33–659)
Other types of events	111925 (95.8%)	\$A14 (10–60)

\*Includes hospitality as well as other costs (eg, venue hire, speaker honoraria, audiovisual hire).

with increased prescribing of promoted, costly, brand-name medications.<sup>15 16</sup>

Finally, we also found a high prevalence of trainee attendance at these events. Targeting medical trainees can lead to a process of normalisation and enculturation while trainees develop their professional identity.<sup>17</sup> This has been described as an effective strategy ‘to influence physicians from the bottom up’.<sup>13</sup> Medical school policies

limiting trainee–industry interaction have been associated with a shift in attitude<sup>18</sup> and reduced prescribing of costly new medicines without therapeutic advantages.<sup>19</sup>

Our study has a number of limitations. First, we relied on reports submitted by companies to Medicines Australia and could not verify the accuracy and completeness of data. Second, since the Code of Conduct’s transparency reporting requirements applies only to members of

**Table 4** The top 20 companies in terms of number of sponsored events

Company	Number of events	Number of attendees	Total cost of food and beverage (\$A)	Total cost of function* (\$A)	Median total cost per event (IQR) (\$A)
AstraZeneca	13968	435686	12 725 027	31 766 776	318 (165–2261)
Novartis	10120	244069	6 600 503	27 467 246	270 (167–1154)
Merck Sharp & Dohme	9142	214621	5 388 247	18 352 116	341 (180–1182)
Roche	7383	174878	2 891 426	16 625 126	186 (129–284)
Pfizer	7125	188439	3 740 677	18 464 785	236 (141–573)
Sanofi	6764	261089	3 243 420	13 668 127	240 (149–600)
Amgen	5562	117767	4 545 874	11 145 245	192 (117–332)
Eli Lilly	5419	138765	2 270 896	7 949 786	145 (62–455)
Servier Lab	4245	145111	4 347 268	14 002 283	482 (196–2252)
Mundipharma	4168	135517	2 956 613	8 939 046	342 (182–2394)
Janssen	3901	140549	3 168 024	14 643 568	320 (164–1818)
GlaxoSmithKline	3706	103331	2 993 037	6 292 242	254 (161–1645)
CSL	3285	138170	1 337 909	6 000 501	288 (179–1427)
Bristol Myers Squibb	3151	138446	2 492 290	12 755 630	245 (82–1900)
Bayer	2964	151084	1 417 055	8 146 292	396 (194–1500)
IPSEN	2802	85475	984477	5 163 600	254 (169–454)
Abbott/AbbVie	2774	59793	3 291 305	6 437 623	255 (157–1037)
Boehringer Ingelheim	2223	56204	6 050 143	8 724 933	2007 (1308–2654)
Gilead Sciences	2049	45510	990419	7 061 338	245 (160–540)
Merck Serono	1841	41809	1 376 023	4 237 372	229 (145–626)
Total – Top 20	102592	3 016 313	72 810 634	247 843 635	262 (152–1199)
All companies	116845	3 481 750	84 862 792	286 117 928	263 (153–1195)

\*Includes food and drink, as well as other costs (eg, venue hire, speaker honoraria, audiovisual hire).



Medicines Australia, the available reports likely underestimate the true extent of industry sponsorship of events for health professionals. Our analysis included only 42 Medicines Australia member companies; as a frame of reference, approximately 140 manufacturers are listed as suppliers to the Australian Pharmaceutical Benefit Scheme.<sup>8</sup> Moreover, non-member manufacturers of branded prescription medicines, generic medicines, over-the-counter medicines and medical devices are not covered by the Medicines Australia Code. Third, with regard to the coding scheme, the research team identified a set of keywords to define each variable of interest, and it is possible that some synonyms were missed due to variability in the data provided. Fourth, we did not assess the content of events due to the unstructured and variable nature of reporting. Fifth, our analysis focuses on industry sponsorship of events and did not examine differences in how event organisers manage potential influences. Finally, costs were not adjusted for inflation as these would likely have a limited impact on the Australian dollar over such a short time period. Notwithstanding these limitations, we have conducted a cross-sectional analysis of the only publicly available data on industry-sponsored events for health professionals.

In conclusion, our findings have several international implications for future research and policy initiatives. While Australian transparency reports are difficult to analyse due to their format, we have created an open-access, searchable, world-first database with details of more than 100 000 industry-sponsored events, enabling researchers to analyse the intersection of pharmaceutical marketing and medical education. Although the data included in this analysis are from Australia, pharmaceutical companies are transnational corporations whose practices are likely to be similar across different countries. Moreover, individual institutions such as hospitals or universities may use these data to see what industry-sponsored activities are happening within their own backyards, and whether they meet contemporary expectations for transparency and independence.

At the policy level, at a time when new rules are being debated and revised globally, our findings underscore the need for more disclosure, not less. Transparency rules should be as inclusive as possible with regard to the type of companies required to report and also in terms of the scope of payments and categories of health professionals covered. The onus of reporting should not be on the industry only; for example, public sector hospitals as well as universities and professional associations could report meal subsidies from pharmaceutical and device manufacturers. A stronger policy option, already implemented at several academic medical centres in the USA, would be to eliminate the provision of free food by manufacturers.<sup>20</sup> In the long term, ways of expanding funding for independent continuing professional education should be explored. There are already case studies showing that independence from industry sponsorship is achievable. For example the University of Michigan, as well as other

major medical institutions in the USA, no longer accepts commercial support for continuing medical education.<sup>21 22</sup> This sets a valuable example that could become a model for other institutions. In the short term, universities and professional associations should make health professionals more aware of the independent sources of information on drugs that are already available (eg, NPS MedicineWise, the Australian Medicines Handbook and the independent drug bulletins).

Finally, our findings highlight that transparency requirements likely capture only a portion of industry sponsorship of events for health professionals. Changes to the transparency requirements will likely exacerbate this issue by excluding common categories of payments. Thus, decision-makers should be aware of the extent of industry-sponsored activity which will be hidden if 'free food' fails to be included in future transparency regimes.

**Contributors** AF, QG, BM, RM, LAB conceived of the study. AF, QG, BM, RM, EW designed the coding scheme. AF, QG and SS acquired and analysed all data. AF drafted the manuscript. All the authors contributed to the writing of the paper and approved the final version. AF is the guarantor.

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**Competing interests** All authors have completed the ICMJE uniform disclosure form at [www.icmje.org/doi\\_disclosure.pdf](http://www.icmje.org/doi_disclosure.pdf) (available on request from the corresponding author). BM reports that she was an expert witness on behalf of plaintiffs in a Canadian class action suit concerning cardiovascular risks of a testosterone gel. None of the authors received any payments, funding or other financial support from pharmaceutical manufacturers. The authors declare no other relationships or activities that could appear to have influenced the submitted work.

**Patient consent** The study did not involve patients.

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**Data sharing statement** The analysable dataset in CSV file format is available at: <http://dx.doi.org/10.4227/11/592631edbd9d5>

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